

# Appendix HYDRO-1

## **Modeling the Potential Effects of Flow Reductions from WRP 4 on Downstream Channel Hydrology and Riparian Vegetation**

The Appendices herein contain supporting information referenced in the Environmental Impact Report. These appendices contain highly detailed figures and other graphic information which are difficult to translate for screen reading software; therefore, the Appendices have not been translated into an auditory format. If you have a disability and/or have difficulty accessing any material in this document, please contact us by mail, email, or telephone, and we will work with you to make all reasonable accommodations. Please indicate 1) the nature of the accessibility need; 2) your preferred format; 3) the material you are trying to access and its location within this document; and 4) how to reach you if questions arise while fulfilling your request. You can direct your requests to William Patterson ([wpatterson@cvwd.org](mailto:wpatterson@cvwd.org)).





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# memorandum

date July 24, 2024

to Carlos Huerta and William Patterson, CVWD

cc

from Andrew Collison, PhD, ESA

subject Modeling the potential effects of flow reductions from WRP 4 on downstream channel hydrology and riparian vegetation

## Overview

The Coachella Valley Water District (CVWD) is proposing to implement the Water Reclamation Plant No. 4 (WRP 4) Non-Potable Water Improvements Project (proposed project) in Thermal, California. The proposed project would involve upgrading treatment at WRP 4 to initially distribute 1 million gallons per day (MGD) of non-potable recycled water for irrigation, with a potential planned expansion up to 10 MGD. The proposed project would be implemented in three phases.

- **Phase 1** would include construction and operation of a 1-MGD treatment plant as part of an overall treatment facility incorporating infrastructure expandable to 2.5 MGD. CVWD would construct facilities enabling supply of a blend of recycled water and canal water to three local customers located south of WRP 4.
- **Phase 2** would incorporate additional equipment at WRP 4 to treat up to 2.5 MGD of tertiary treated recycled water, with onsite infrastructure expandable to 10 MGD.
- **Phase 3** includes incorporating additional equipment to treat up to 10 MGD of tertiary treated recycled water.

The proposed project would reduce the volume of water discharged to the Coachella Valley Stormwater Channel (CVSC), a constructed channel that conveys stormwater flows from the Whitewater River, stormwater runoff from surrounding areas, agricultural subsurface drainage, flows from fish farm, and treated WRP discharge from WRP 4, Coachella Sanitary District, and Valley Sanitary District sewage treatment plants to the Salton Sea. The CVSC contains a mixture of disturbed ground, native and non-native vegetation around the pilot channel, and some of the vegetation is potentially supported by flows down the channel in addition to other sources such as rainfall and groundwater. Additionally, animals may use the CVSC for habitat or as a movement corridor. To assess whether the proposed project could

impact vegetation and aquatic habitat within the CVSC by reducing flows in the pilot channel<sup>1</sup>, ESA conducted three sets of analysis that are described in this technical memorandum:

1. Developed a water budget for the CVSC based on flow data collected by CVWD and the USGS at four locations along the channel. This allows the contribution of WRP 4 discharge flows to CVSC baseflows<sup>2</sup> to be identified, and estimations of the proportional flow reduction to the CVSC to be made under the proposed project.
2. Mapped vegetation within the CVSC and estimated its evapotranspiration demands for comparison with the water budget developed in Step 1. This demonstrates how much water is needed to supply the existing habitat and whether that will still be met under the proposed project conditions.
3. Ran average flows under existing and proposed project conditions (from Step 1) through a hydraulic model to estimate the effect of the three proposed project phases on flow depth and wetted area along the pilot channel. This provides a measure of how much shallower and narrower flows will be under project conditions.

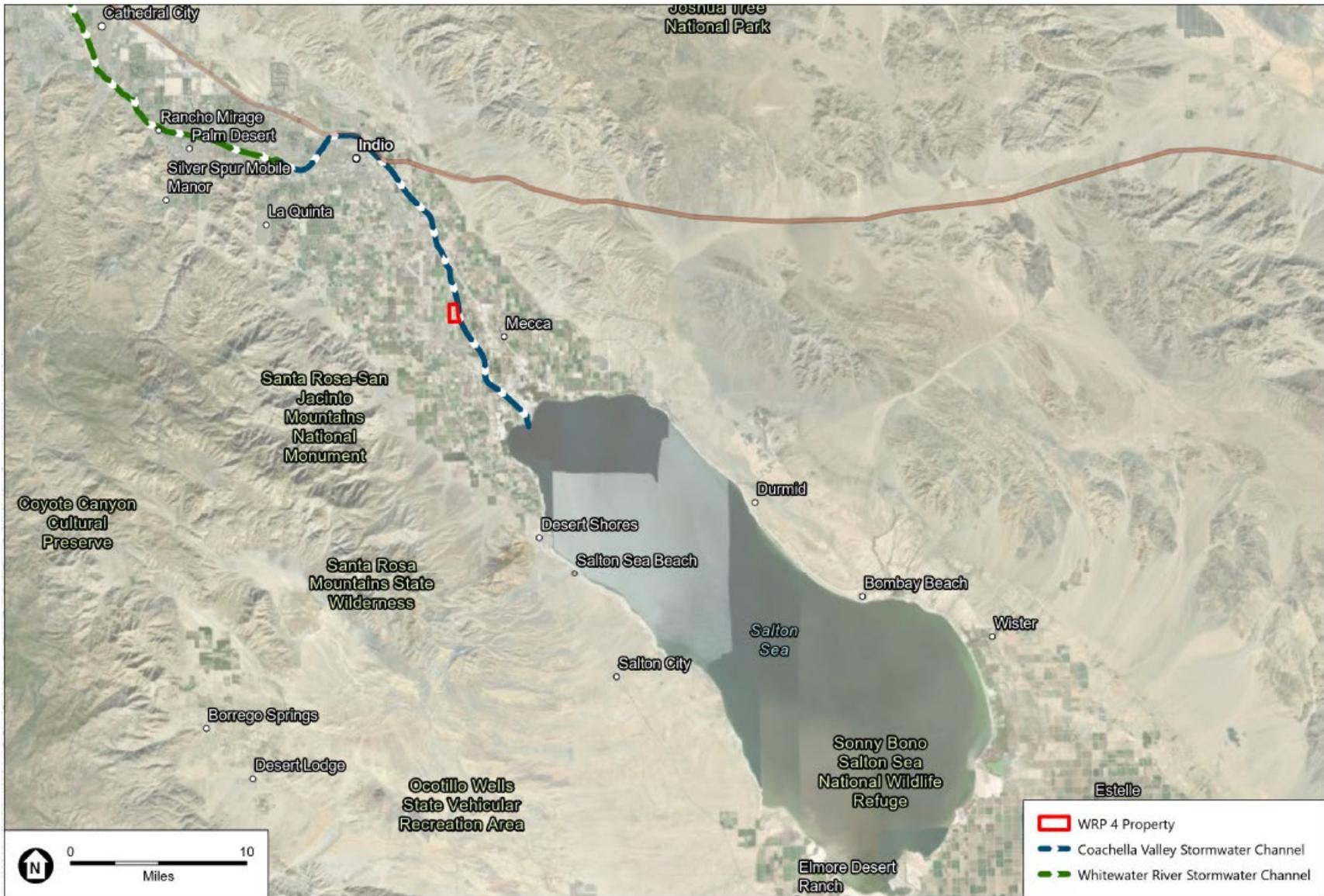
## Site Location and Hydrology

WRP 4 is located alongside the CVSC eight miles upstream of the Salton Sea (**Figure 1**). Described from upstream to downstream, the key channel features are as follows. The Whitewater River is an ephemeral river with its headwaters in the San Bernardino Mountains. Around East Vista Chino in Palm Springs the Whitewater River becomes contained in the Whitewater River Stormwater Channel which conveys flow for 16 miles to Washington Street in La Quinta, where the channel continues as the CVSC, which is the realignment of the downstream reach of the Whitewater River Stormwater Channel. The CVSC is approximately 17 miles long from Washington Street to its terminus in the Salton Sea. The combined Whitewater River and CVSC watershed has an area of 1,073 square miles at the USGS flow gauge 10259300 Whitewater River at Indio (approximately 13 miles upstream of WRP 4), and 1,495 square miles at the USGS gauge 10259540 Whitewater River near Mecca (approximately 7 miles downstream of WRP 4). The average annual precipitation for the watershed is 4.7 inches (USGS StreamStats). From the northern end of the Whitewater River Stormwater Channel at East Vista Chino Road for 23 miles to the Valley Sanitary District sewage treatment plant in Indio, the Whitewater River Stormwater Channel and CVSC are ephemeral. This can be seen in records from the USGS flow gauge Whitewater River at Indio – 10259300, which is located three miles upstream of the Valley Sanitary District treatment plant. Downstream of the Valley Sanitary District effluent discharge point the channel becomes perennial, with a narrow flow channel and riparian corridor that extend all the way to the Salton Sea. The perennial nature of the downstream channel is demonstrated by a second USGS gauge 10259540 Whitewater River near Mecca (referred to in this memo as the Lincoln Street gauge) which shows continuous flows exceeding 45 cfs even during the summer months, winter months, and in periods of drought. Key locations used in the hydrologic analysis are shown in **Figure 2**.

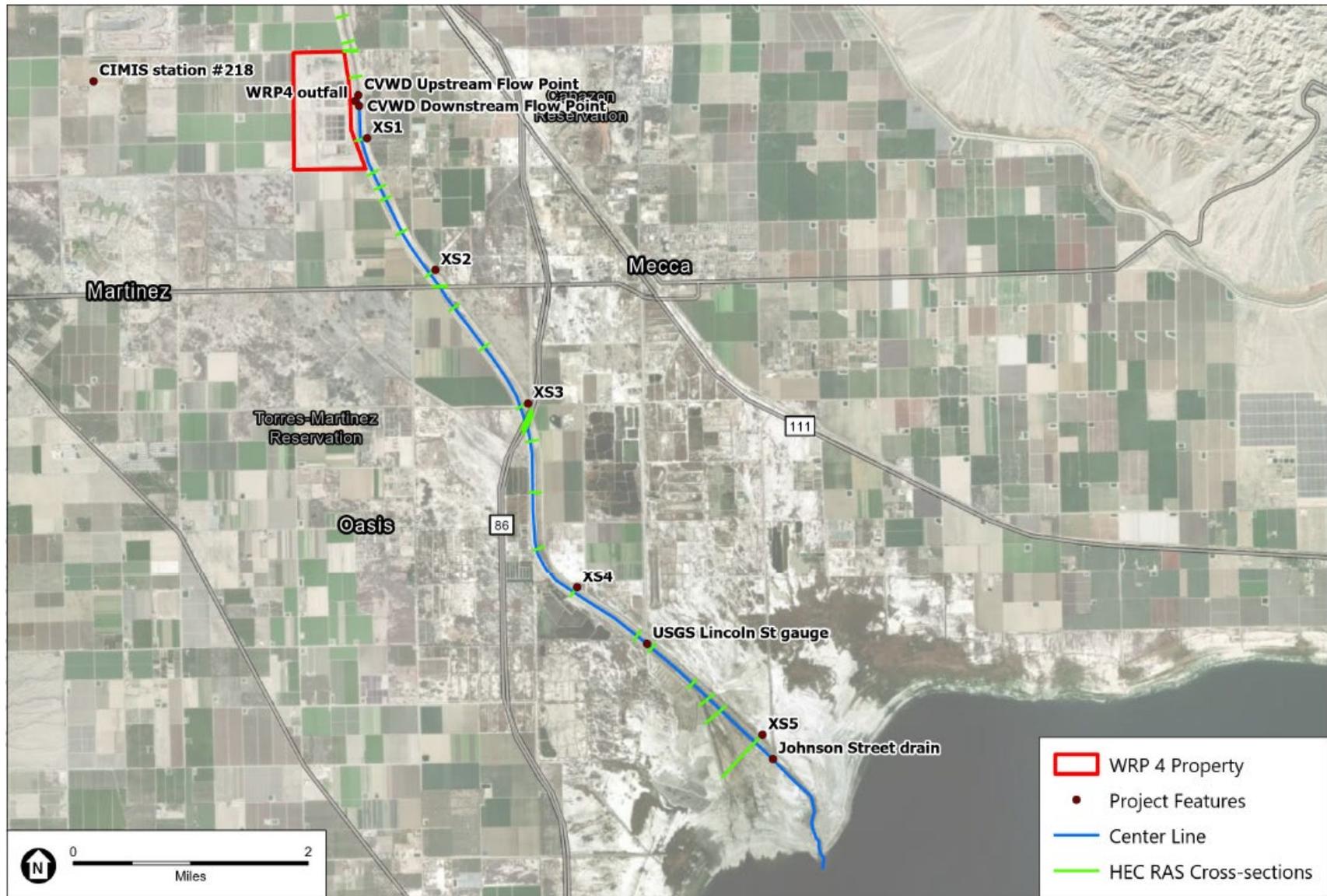
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<sup>1</sup> The pilot channel is the portion of the channel within the wider CVSC that concentrates baseflows.

<sup>2</sup> Baseflows refer to typical flows between less common rainfall – runoff events.



**Figure 1**  
Location of the WRP 4 project



**Figure 2**  
Flow measurement locations and hydraulic model (HEC RAS) cross sections used in the hydrologic analysis

## Step 1. Water Budget and Channel Hydrology

A water budget for the CVSC downstream of WRP 4 was developed using daily data from the Lincoln Street USGS gauge and 40 sets of flow measurements made by CVWD on an approximately monthly basis between 2018 and 2023. The CVWD measurements were made immediately upstream and downstream of WRP 4, showing the contribution of WRP 4 to overall flows. For the period from 2018 to 2023 the mean flow upstream of WRP 4 was 25.1 cfs, and the mean flow immediately downstream was 32.8 cfs, indicating a mean WRP 4 discharge of 7.6 cfs (accounting for rounding). Mean flow at the Lincoln Street USGS gauge was 65.6 cfs, indicating that on average 32.8 cfs of additional flow enters the CVSC downstream of WRP 4 from agricultural drain flows, thereby doubling its flow. Baseflows are relatively steady between rainfall-driven peak flow events: the standard deviation in flows upstream and downstream of WRP 4 is between 3 and 4 cfs (11-12% of the mean), and the minimum flow measured above WRP 4 between 2018 and 2023 was 18.3 cfs. The minimum flow recorded at the Lincoln Street gauge was 40.2 cfs for the period from 2018-2023. **Figure 3** shows the time series of flow measurements between 2018 and 2023 used to develop the water budget.

To assess potential project effects on the water budget, the maximum potential WRP reuse capacity for the first two project phases was deducted from the mean observed WRP 4 discharge. For Phase 3 the maximum potential reuse capacity exceeds the mean WRP 4 discharge, so the mean WRP 4 discharge was assumed to be zero for that phase. The resulting flow estimates are shown in **Table 1**. Project effects were estimated immediately downstream of WRP 4, and at the Lincoln Street gauge. These two locations bookend the potential flows at the upstream and downstream ends of the CVSC between WRP 4 and close to the Salton Sea. The estimated project effects are conservative in that they exclude high flows due to rainfall events (during which WRP4 flows are proportionately much smaller) and focus on baseflow between runoff events.

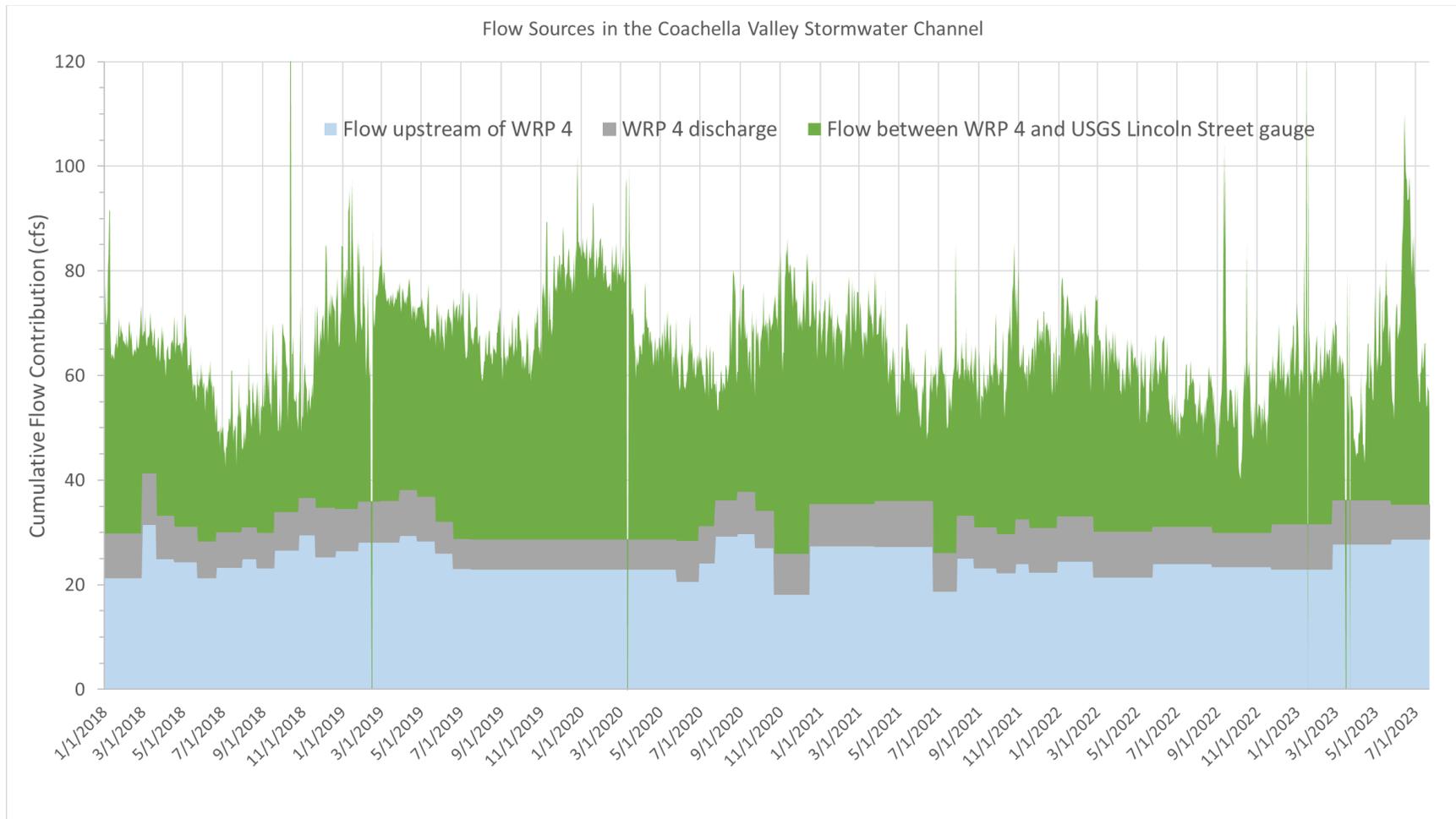
**TABLE 1**  
**EXISTING AND PROPOSED PROJECT FLOWS BASED ON MEASURED FLOWS BETWEEN JAN 2018 AND JULY 2023**

Flows Run for Channel Hydraulic Model	Existing conditions	Phase 1	Phase 2	Phase 3
Mean Flow Upstream of WRP 4 (cfs)	25.1	25.1	25.1	25.1
Mean WRP 4 Discharge (cfs)	7.6	6.1	3.8	0.0
Mean Flow Immediately Downstream of WRP 4 (cfs)	32.8	31.2	28.9	25.1
Mean Flow at USGS Lincoln St Gauge (nr. Salton Sea) (cfs)	65.6	64.1	61.8	58.0

Notes:

1. Mean WRP 4 discharge in Phases 1 and 2 is assumed to be existing mean WRP 4 discharge minus discharge reuse capacity for the relevant project phase
2. Phase 3 WRP 4 discharge is assumed to be zero since Phase 3 discharge reuse capacity exceeds existing mean WRP 4 discharge

As shown in Table 1, WRP 4 discharge accounts for 23% of mean baseflow in the CVSC immediately downstream of WRP 4, and 12% of mean baseflow at Lincoln Street, close to the Salton Sea.



**Figure 3**  
Time series of flows upstream and downstream of WRP 4 (approximately monthly) and the Lincoln Street USGS gauge (daily), 2018-2023

## Step 2. Water Requirements of Vegetation in the Coachella Valley Stormwater Channel

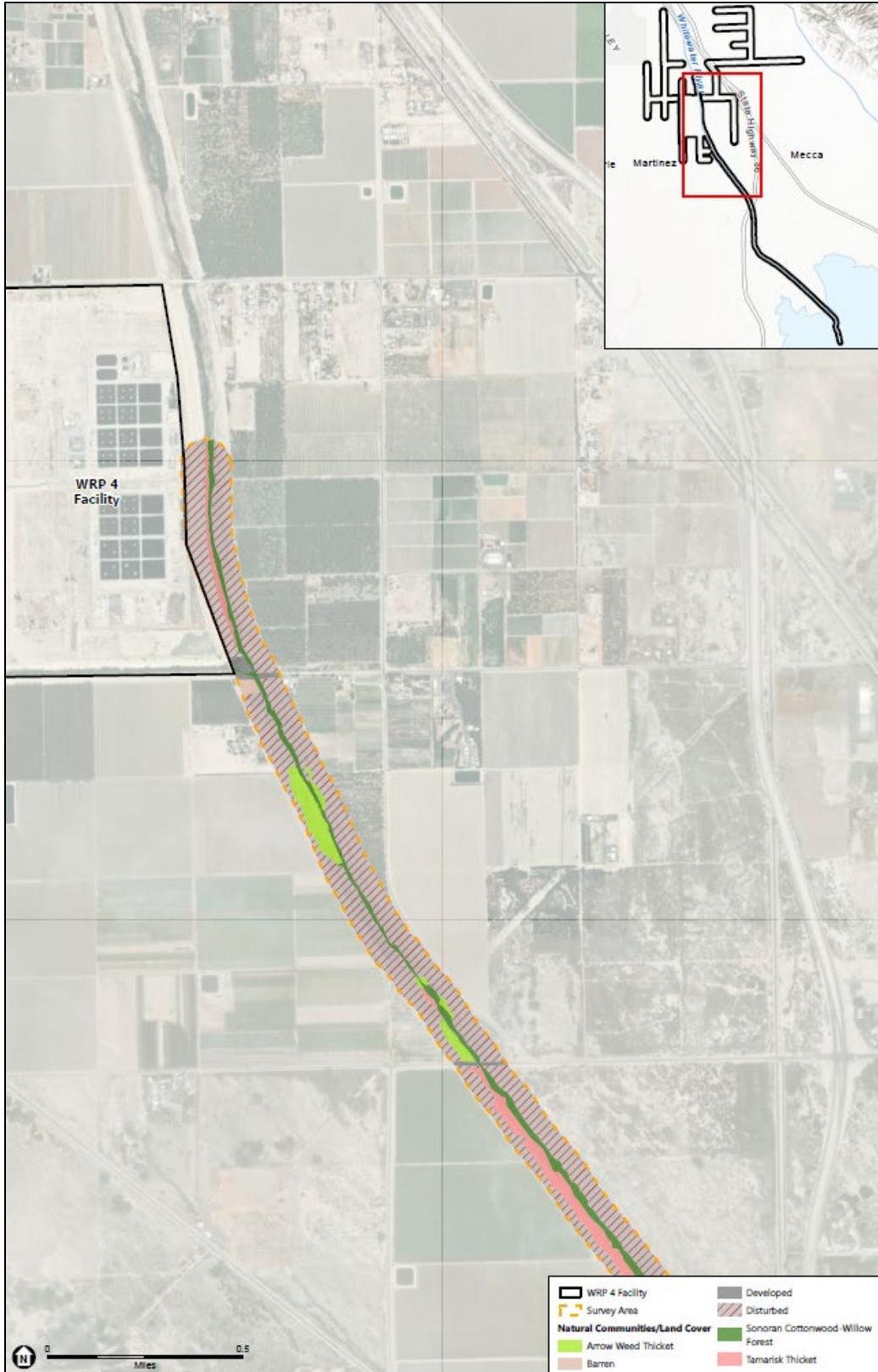
The purpose of Step 2 was to quantify the area of vegetation in the CVSC that might derive some or all of its water needs from flow in the channel, estimate the annual evapotranspiration (i.e. the process by which water is transferred from the land to the atmosphere;  $ET_v$ ) rate for the vegetation, and compare that with the available water under existing and proposed project conditions from Step 1. This approach is a conservative way to assess potential project effects on vegetation in that it assumes that vegetation in the CVSC derives 100% of its water supply from channel flow that seeps laterally into the soil around the pilot channel, rather than a portion from rainfall or groundwater.

Vegetation cover within the CVSC was assessed through a combination of driving and walking along the CVSC to map existing natural communities and land cover types, and to assess the potential for special-status plants and wildlife to occur. All native and non-native natural communities and land cover types were mapped on aerial maps using Geographic Information System software (i.e., ArcGIS). Most descriptions of vegetation were characterized in the field in accordance with A Manual of California Vegetation (MCV); however, in instances where a description listed in the MCV was not appropriate, the community was instead characterized using species dominance or other notable descriptor. The results within the CVSC footprint are shown in **Figure 4** and the breakdown of vegetation types is shown in **Table 2**. Six land cover types were not treated as channel-fed vegetation, and were excluded from the ET analysis: these are agriculture, barren land, developed land, disturbed land, salt-panne, and the unvegetated channel bed. Evapotranspiration was calculated by using meteorological data to estimate the evapotranspiration rate for a reference cover,  $Et_0$ , (an irrigated grass surface) and applying a crop adjustment factor,  $K_v$ , to yield an estimated rate for the target vegetation type,  $Et_v$ . Crop adjustment factors have been calculated for a range of commercial crops and some native vegetation types (e.g., cattail marsh, willow, and cottonwood, Howes et al., 2015), but were not available for all the covers present in the CVSC. Where no crop adjustment factors were available, the riparian species most comparable to the vegetation type in the CVSC was selected based on plant physiology. For example, tamarisk, iodine bush scrub and arrow weed were modeled using the crop adjustment factor of willow, while bush seepweed scrub and salt grass flats were modeled using the crop factor of small stand permanent wetlands (SSPW). Monthly and annual reference cover  $Et_0$  rates were obtained from the California Irrigation Management Information System (CIMIS) meteorological station 218 at Thermal South, 2 miles west of WRP 4. The results are shown in Table 2 and **Figure 5**. Raw values of  $Et_0$  for the study area and crop adjustment factors are included as **Attachment A** to this memorandum.

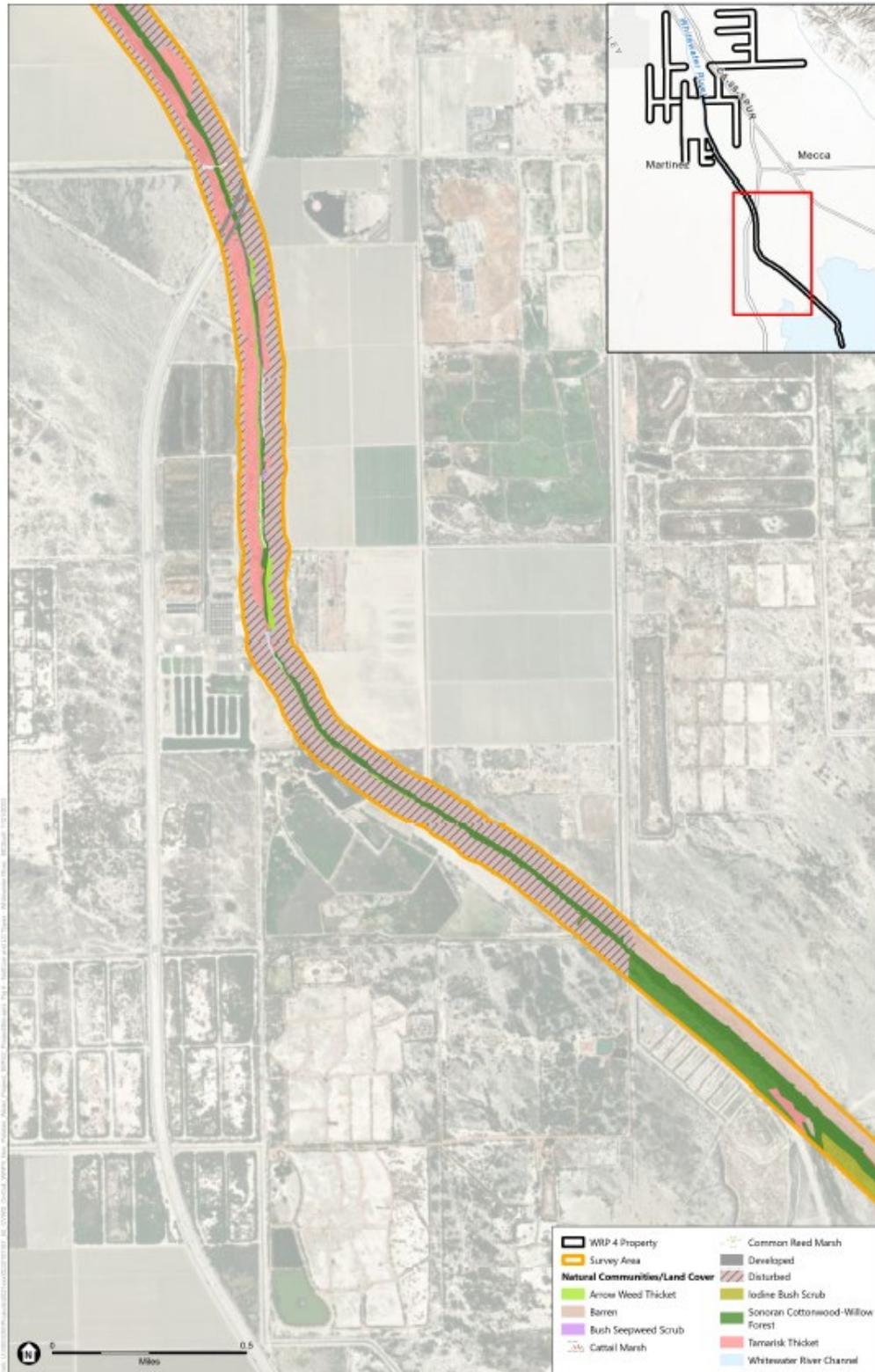
**TABLE 2  
VEGETATION TYPES AND EVAPOTRANSPIRATION DEMAND FOR VEGETATION WITHIN THE COACHELLA VALLEY  
STORMWATER CHANNEL**

<b>Vegetation Type in CVSC (and Equivalent Riparian Cover Used for ET<sub>v</sub> Estimation)</b>	<b>Area (AC)</b>	<b>Area Potentially Supplied by Channel Flow (AC)</b>	<b>ET<sub>v</sub> Demand (AFY)</b>	<b>ET<sub>v</sub> Demand (cfs)</b>
Agriculture	0.59	Na1	-	-
Arrow Weed Thicket (willow)	18.8	18.8	100	0.14
Barren	66.3	Na1	-	-
Bush Seepweed Scrub (SSPW)	0.4	0.4	4	0.01
Cattail Marsh (SSPW)	1.2	1.2	12	0.02
Common Reed Marsh (SSPW)	1.5	1.5	14	0.02
Developed	9.7	Na2	-	-
Disturbed	343.0	Na2	-	-
Iodine Bush Scrub (willow)	42.9	42.9	228	0.31
Salt-Panne	7.6	Na1	-	-
Salt Grass Flats (SSPW)	0.3	0.3	3	0.00
Sonoran Cottonwood-Willow Forest (cottonwood)	98.1	98.1	556	0.77
Tamarisk Thicket (cottonwood)	85.18	85.2	482	0.67
Whitewater River Channel	0.32	Na3	-	-
<b>TOTAL</b>	<b>675.76</b>	<b>248.3</b>	<b>1,397</b>	<b>1.93</b>

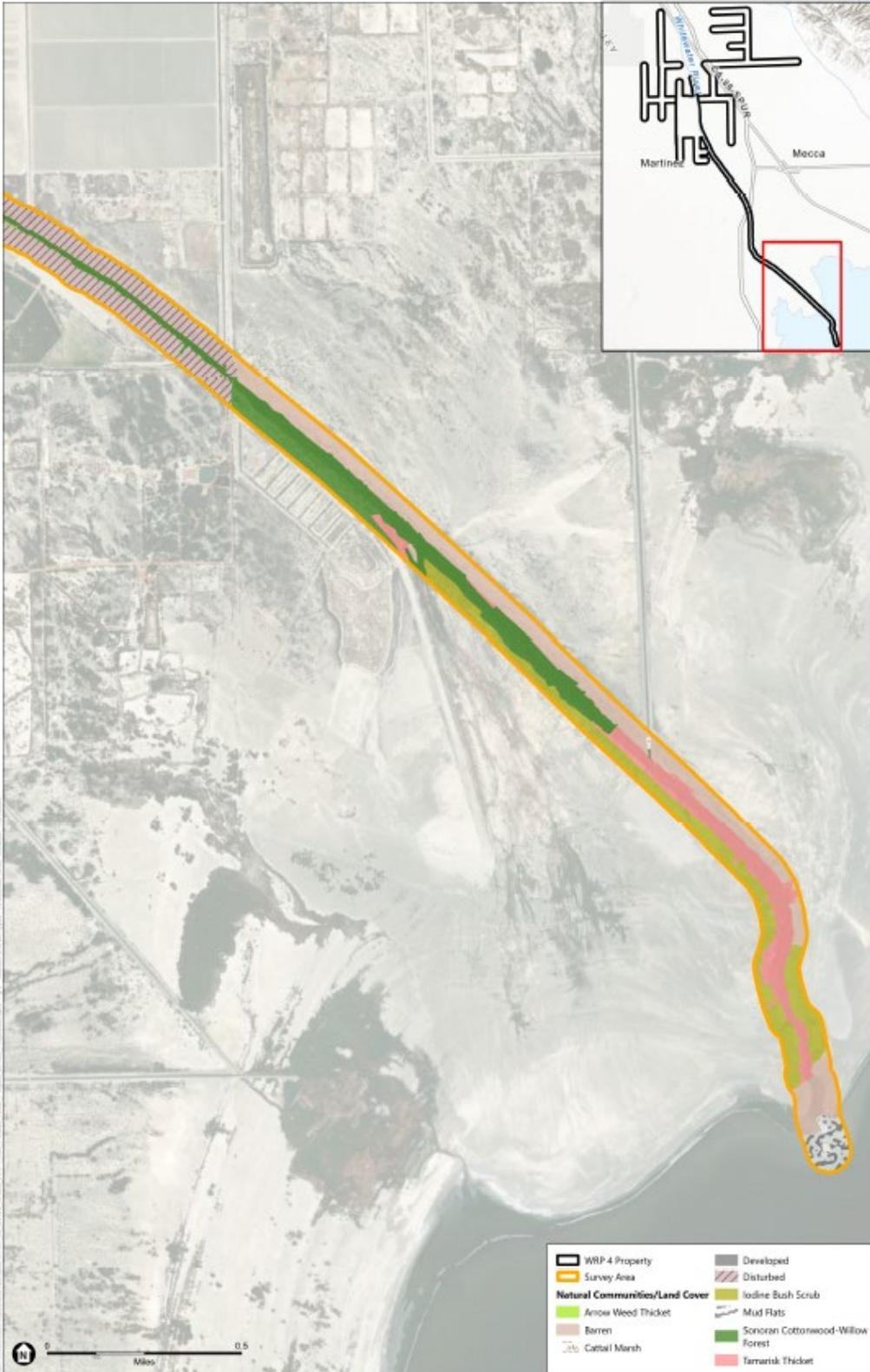
Notes. The land covers indicated above were excluded from the analysis for the following reasons 1. Agriculture, barren and salt-panne are shallow rooted upland land covers that are supplied with water by rainfall. 2. Developed and disturbed lands have no vegetation cover or a sparse upland grass cover and are assumed to have either no ET demand or to be supplied by rainfall. 3. River channel is unvegetated.



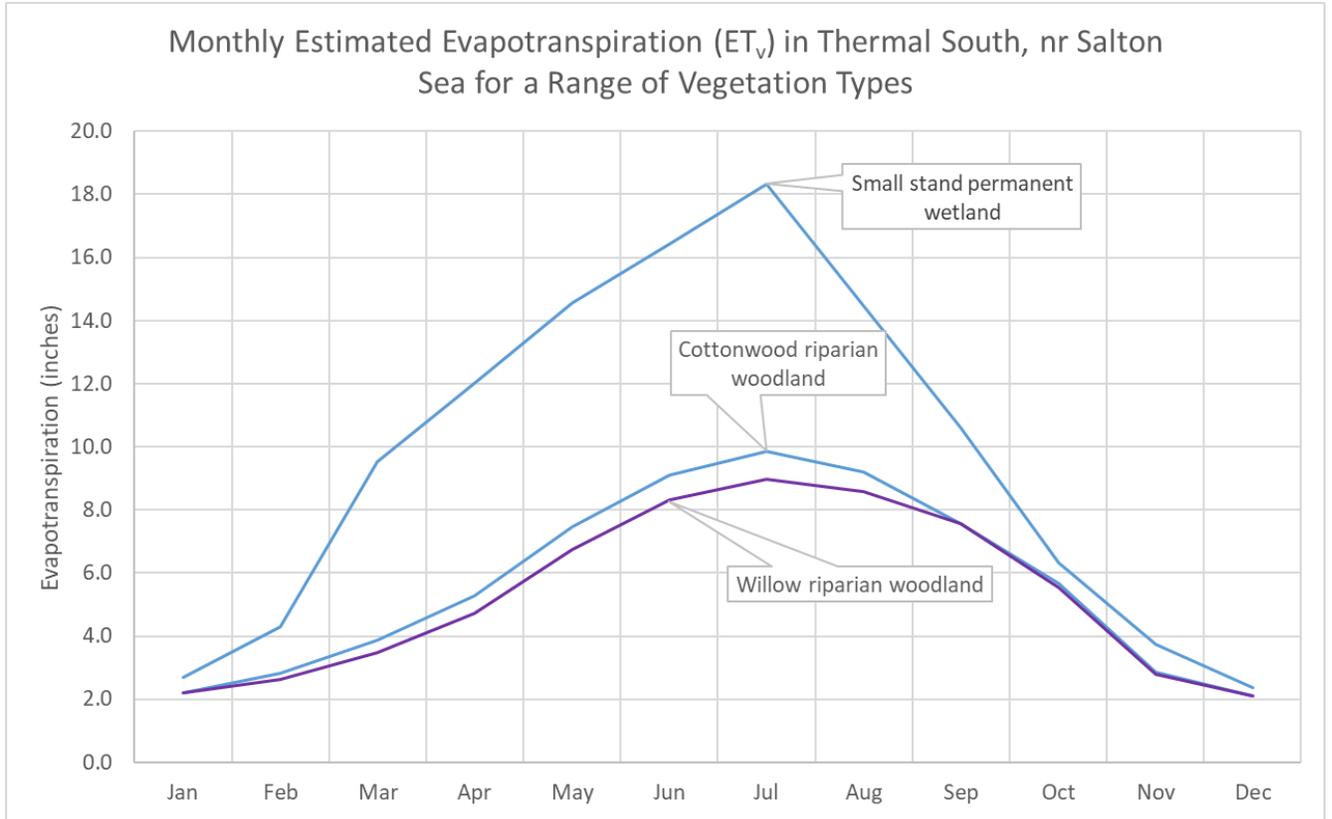
**Figure 4a**  
Land covers within the Coachella Valley Stormwater Channel



**Figure 4b**  
Land covers within the Coachella Valley Stormwater Channel



**Figure 4c**  
Land covers within the Coachella Valley Stormwater Channel



**Figure 5**  
Estimated evapotranspiration ( $ET_v$ ) for riparian land covers within the Coachella Valley Stormwater Channel

There is a total of 676 acres of land within the CVSC between WRP 4 and the Salton Sea, of which 63% is classified as disturbed, barren, developed, unvegetated channel bed or salt panne, and so assumed to not be dependent on streamflow as a water source. A total of 248 acres were designated as potentially channel fed and were used to estimate the ET<sub>v</sub> demand. The total ET<sub>v</sub> demand was calculated as 1,397-acre feet per year, which corresponds to 1.9 cubic feet per second of water. This value was compared with the available streamflow under existing and proposed conditions (**Table 3**). As can be seen in **Table 4**, the ET<sub>v</sub> demand of the vegetation within the CVSC is an order of magnitude less than the volume of water flowing through the channel under existing conditions and all three phases of the proposed project, in all locations between WRP 4 and the Lincoln Street gauge near the Salton Sea. Under existing conditions ET<sub>v</sub> demand is 6% of flow immediately downstream of WRP 4; if WRP 4 flows were reduced to zero (equivalent to Phase 3 of the proposed project) the ET demand would be 8% of the available flow. As a more conservative comparison of ET<sub>v</sub> demand and water supply, we compared the ET<sub>v</sub> water demand with the minimum flow measured upstream of WRP 4 throughout the six years of flow monitoring, representing a condition of zero flow from WRP 4 during summer of a drought. In that scenario the ET<sub>v</sub> demand was 10% of the available flow. Comparing ET<sub>v</sub> demand and water availability further downstream at the Lincoln Street gauge the project effects are proportionately smaller, since there is more water supply downstream. We therefore conclude that the proposed project would not impact water availability for riparian habitat in the CVSC.

**TABLE 3**  
**VEGETATION EVAPOTRANSPIRATION DEMAND COMPARED WITH AVAILABLE STREAMFLOW**  
**UNDER EXISTING AND PROPOSED PROJECT CONDITIONS**

<b>ET<sub>v</sub> demand in CVSC from potential channel-fed habitat</b>	<b>1.9 cfs</b>
Minimum flow measured upstream of WRP 4 (2018-2023)	18.3 cfs
ET <sub>v</sub> demand as percent of flow	10%
Mean flow downstream of WRP 4 (Existing Conditions)	32.8 cfs
ET <sub>v</sub> demand as percent of flow	6%
Mean flow downstream of WRP 4 (Phase 3)	25.1 cfs
ET <sub>v</sub> demand as percent of flow	8%
Minimum flow measured at Lincoln St USGS gauge (2018-2023)	40.2 cfs
ET <sub>v</sub> demand as percent of flow	5%
Mean flow at Lincoln St USGS gauge (Existing Conditions)	65.6 cfs
ET <sub>v</sub> demand as percent of flow	3%
Mean flow at Lincoln St USGS gauge (Phase 3)	58 cfs
ET <sub>v</sub> demand as percent of flow	3%

**TABLE 4**  
**ESTIMATE FLOW DEPTH IN THE COACHELLA VALLEY STORM CHANNEL UNDER EXISTING AND PROPOSED CONDITIONS**

Flow downstream of WRP 4								Flow at USGS Lincoln Street gauge							
Channel XS Station	Existing Conditions	Phase 1		Phase 2		Phase 3		Channel XS Station	Existing Conditions	Phase 1		Phase 2		Phase 3	
	Depth (ft)	Depth (ft)	Δ (ft)	Depth (ft)	Δ (ft)	Depth (ft)	Δ (ft)		Depth (ft)	Depth (ft)	Δ (ft)	Depth (ft)	Δ (ft)	Depth (ft)	Δ (ft)
(XS-1) 40769	2.28	2.23	0.05	2.16	0.12	2.03	0.25	(XS-1) 40769	3.06	3.04	0.02	2.99	0.07	2.91	0.15
39188	0.41	0.39	0.0200	0.38	0.03	0.35	0.06	39188	0.64	0.6	0.04	0.57	0.07	0.55	0.09
38458	2.15	2.11	0.04	2.06	0.09	1.97	0.18	38458	2.78	2.75	0.03	2.71	0.07	2.65	0.13
37897	1.38	1.34	0.04	1.29	0.09	1.2	0.18	37897	1.98	1.96	0.02	1.92	0.06	1.86	0.12
36229	1.39	1.36	0.03	1.3	0.09	1.21	0.18	36229	1.97	1.95	0.02	1.91	0.06	1.85	0.12
(XS-2) 33976	0.86	0.83	0.03	0.8	0.06	0.75	0.11	(XS-2) 33976	1.29	1.27	0.02	1.23	0.06	1.17	0.12
33247	1.91	1.87	0.04	1.81	0.10	1.71	0.20	33247	2.44	2.43	0.01	2.42	0.02	2.39	0.05
33195	2.27	2.24	0.03	2.18	0.09	2.07	0.20	33195	2.77	2.77	0.00	2.76	0.01	2.76	0.01
32152	0.69	0.68	0.01	0.66	0.03	0.62	0.07	32152	1.09	1.06	0.03	0.99	0.10	0.87	0.22
29918	2.48	2.44	0.04	2.36	0.12	2.24	0.24	29918	3.29	3.26	0.03	3.21	0.08	3.13	0.16
(XS-3) 26769	0.65	0.63	0.02	0.6	0.05	0.54	0.11	(XS-3) 26769	0.99	0.98	0.01	0.96	0.03	0.92	0.07
26195	1.04	1.01	0.03	0.98	0.06	0.92	0.12	26195	1.49	1.48	0.01	1.45	0.04	1.4	0.09
26133	0.78	0.74	0.04	0.7	0.08	0.61	0.17	26133	1.29	1.27	0.02	1.24	0.05	1.19	0.10
26004	1.76	1.73	0.03	1.68	0.08	1.6	0.16	26004	2.25	2.23	0.02	2.2	0.05	2.15	0.10
25940	1.72	1.69	0.03	1.64	0.08	1.57	0.15	25940	2.18	2.17	0.01	2.14	0.04	2.09	0.09
25121	1.31	1.29	0.02	1.26	0.05	1.21	0.10	25121	1.62	1.6	0.02	1.59	0.03	1.55	0.07
22809	0.64	0.62	0.02	0.58	0.06	0.52	0.12	22809	0.95	0.94	0.01	0.92	0.03	0.89	0.06
20283	0.72	0.71	0.01	0.69	0.03	0.66	0.06	20283	0.96	0.95	0.01	0.93	0.03	0.91	0.05
(XS-4) 17688	0.41	0.39	0.02	0.36	0.05	0.31	0.10	(XS-4) 17688	0.73	0.72	0.01	0.7	0.03	0.66	0.07
14222	1.43	1.41	0.02	1.38	0.05	1.32	0.11	14222	1.73	1.72	0.01	1.7	0.03	1.67	0.06
13355	0.36	0.35	0.01	0.34	0.02	0.32	0.04	13355	0.47	0.46	0.01	0.46	0.01	0.45	0.02
10930	2.06	2.04	0.02	2	0.06	1.93	0.13	10930	2.5	2.48	0.02	2.46	0.04	2.41	0.09
9955	1.31	1.28	0.03	1.24	0.07	1.17	0.14	9955	1.72	1.71	0.01	1.68	0.04	1.64	0.08
9179	1.17	1.15	0.02	1.11	0.06	1.05	0.12	9179	1.54	1.53	0.01	1.5	0.04	1.47	0.07
(XS-5) 7087	2.38	2.37	0.01	2.35	0.03	2.31	0.07	(XS-5) 7087	2.61	2.61	0.00	2.59	0.02	2.57	0.04
<b>Average of all cross sections</b>	<b>1.34</b>	<b>1.32</b>	<b>0.03</b>	<b>1.28</b>	<b>0.07</b>	<b>1.21</b>	<b>0.13</b>	<b>Average of all cross sections</b>	<b>1.77</b>	<b>1.76</b>	<b>0.02</b>	<b>1.73</b>	<b>0.04</b>	<b>1.68</b>	<b>0.09</b>
<b>Percent Change from Existing Conditions</b>			<b>-2%</b>		<b>-5%</b>		<b>-10%</b>	<b>Percent Change from Existing Conditions</b>			<b>-1%</b>		<b>-3%</b>		<b>-5%</b>

## Step 3. Hydraulic Analysis of Flow Reduction on Channel Hydrology

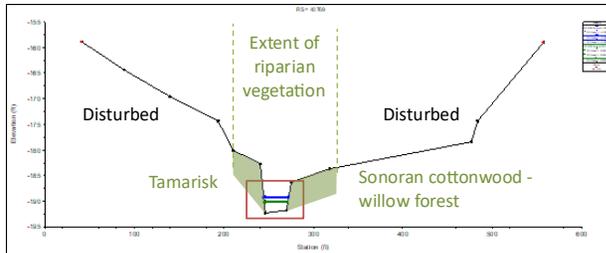
To assess the effect of reducing or eliminating flows from WRP 4 on the channel downstream, the flows estimated in Table 1 were applied to a hydraulic model of the CVSC that had previously been developed (NHC, 2012) using the US Army Corps of Engineers HEC RAS software. The model was constructed by NHC around 2012 for the FEMA re-mapping of the reach from Monroe Drop to the Salton Sea using topographic cross sections of the channel and all bridges and drop structures surveyed in 2010. Hydraulic roughness was estimated using standard methods developed by the US Geological Survey (NHC, 2012). The model was reviewed and approved by FEMA for re-mapping this reach, which was implemented as a Physical Map Revision. CVWD worked directly with stakeholders as part of a Local Levee Partnership Team (LLPT) on the project.

Hydraulic models simulate flows passing through channel cross sections based on the flow rate applied at the upstream boundary, the channel cross section geometry, channel gradient, hydraulic roughness (cross section friction due to vegetation and sediment) and the water level at the downstream boundary. The model simulates the Whitewater River Stormwater Channel and the CVSC from East Vista Chino to the Salton Sea. The 8-mile reach from WRP 4 to the Salton Sea is represented by 25 model cross sections (Figure 2). Flows from Table 1 were applied to the model, and the resulting water surface elevations at each cross section were output<sup>3</sup> (see **Figures 6–10** which show five representative cross sections with the associated vegetation covers from Figure 4 superimposed). The figures also show a six-foot vertical zone below the vegetation on the channel edge, as a visual guide to the magnitude of water depth changes relative to rooting depths. Based on the Nature Conservancy riparian plant rooting depth database (TNC, 20024) 50% of riparian species catalogued have a maximum rooting depth of 6 feet or more below ground level. The cross sections were selected to be roughly evenly spaced and representative of the channel width and depth for the reaches around them. The flows represent existing conditions at two locations and for the three project phases: immediately downstream of WRP 4 and at the Lincoln Street USGS gauge. The flow depth and wetted width for all 25 cross sections between WRP 4 and the Salton Sea were output and shown in **Tables 4 and 5**.

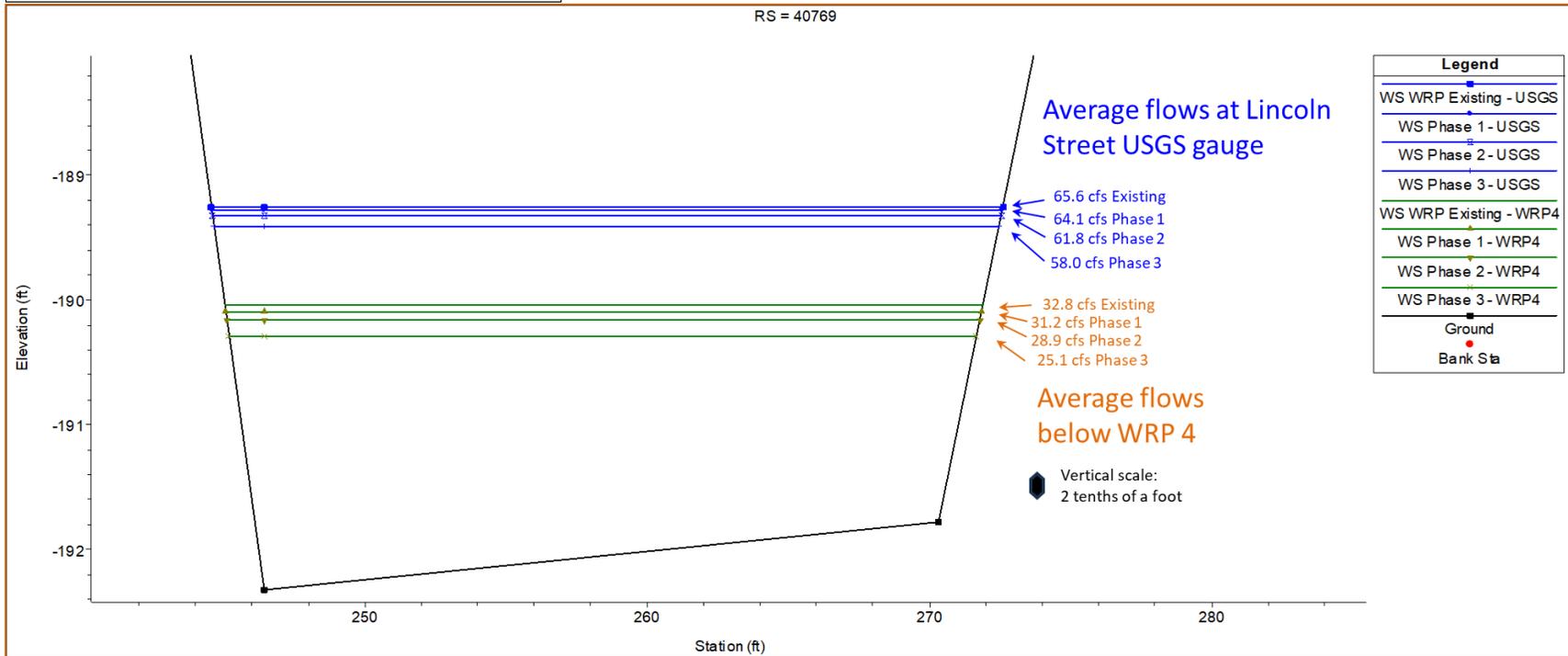
Phases 1 and 2 of the proposed project would have almost undetectable effects on flow depth (a few hundredths of a foot at most cross sections in Phase 1 for flow volumes immediately below WRP 4, and less than a tenth of a foot on average for Phase 2). The effect would be even smaller further downstream, as more watershed flow inputs dilute the effect of the WRP 4 flow reduction. Phase 3 would lower water levels by just over a tenth of a foot on average based on flows at WRP 4 representing an 10% reduction in depth, and by less than a tenth of a foot on average based on flows near the Lincoln Street USGS gauge representing a 5% reduction in depth. For all the cross sections the post project flow level would be well within the estimated plant root zone shown and therefore would not impact the ability of riparian vegetation to draw soil moisture from the channel.

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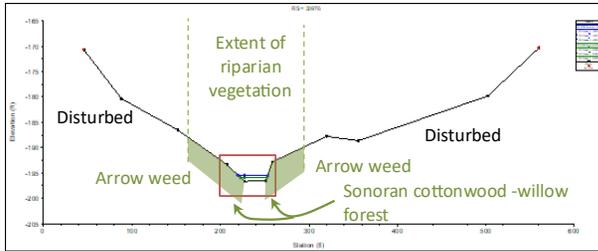
<sup>3</sup> Flows have been measured at WRP 4 (upstream) and Lincoln Street (close to the downstream limit of the study area), but not at each individual cross section. Figures 6-10 and Tables 4 and 5 show the values as measured at the two locations. For cross sections between these two locations the typical water level and the changes in water level with project phases will be between the two set of elevations shown.



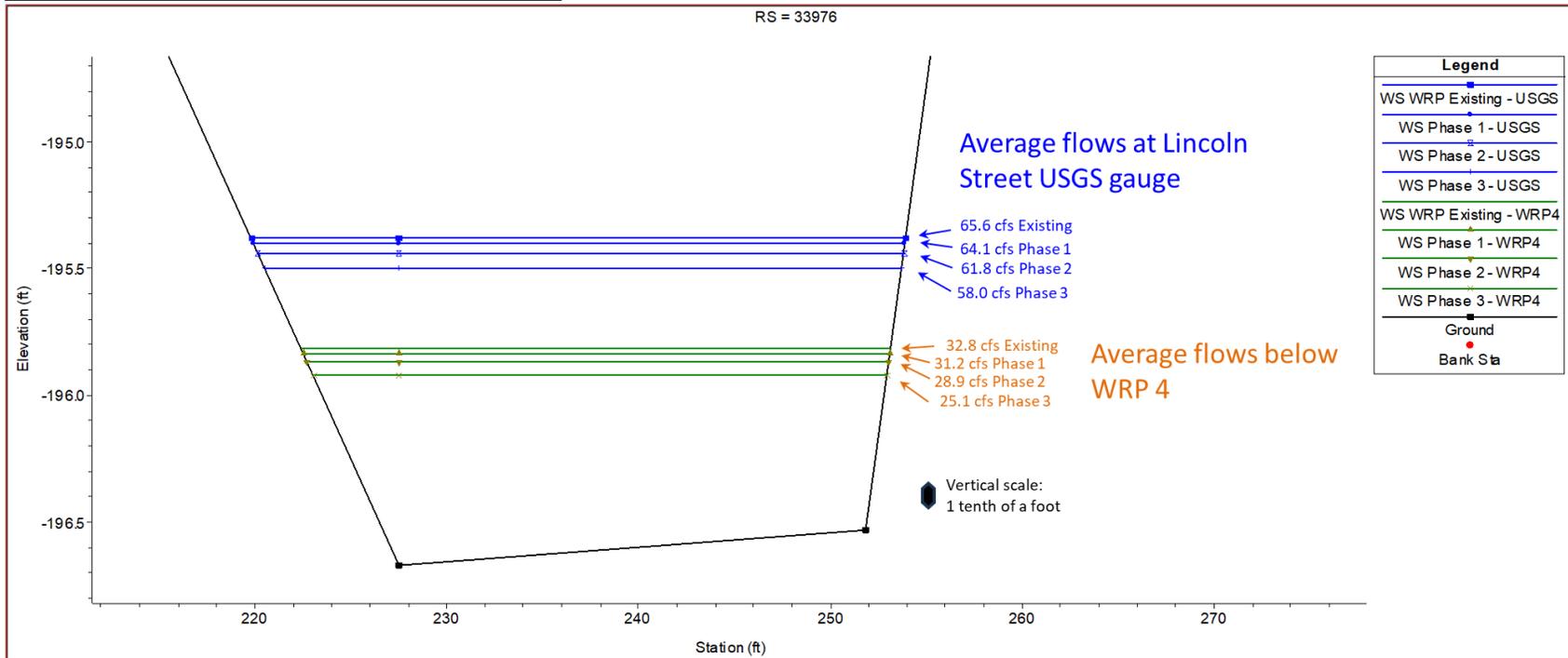
Cross Section 1. Immediately downstream of WRP 4



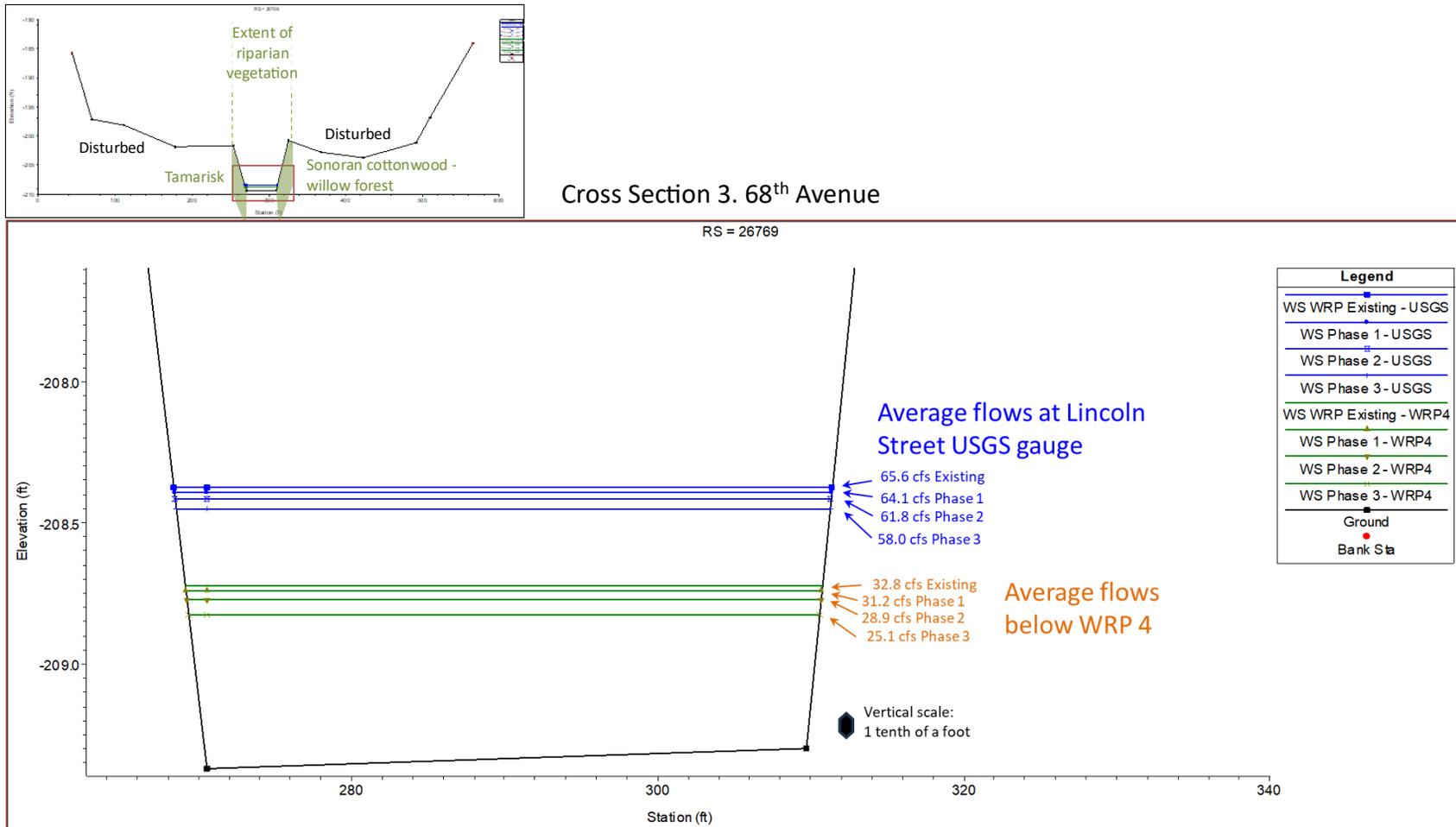
**Figure 6**  
 Estimated changes in baseflow depth and width in the Coachella Valley Stormwater Channel: Cross section 1 - immediately downstream of WRP 4



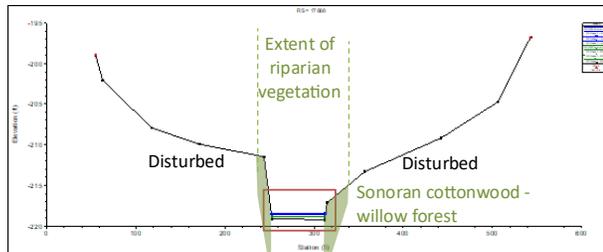
Cross Section 2. Upstream of 66<sup>th</sup> Avenue



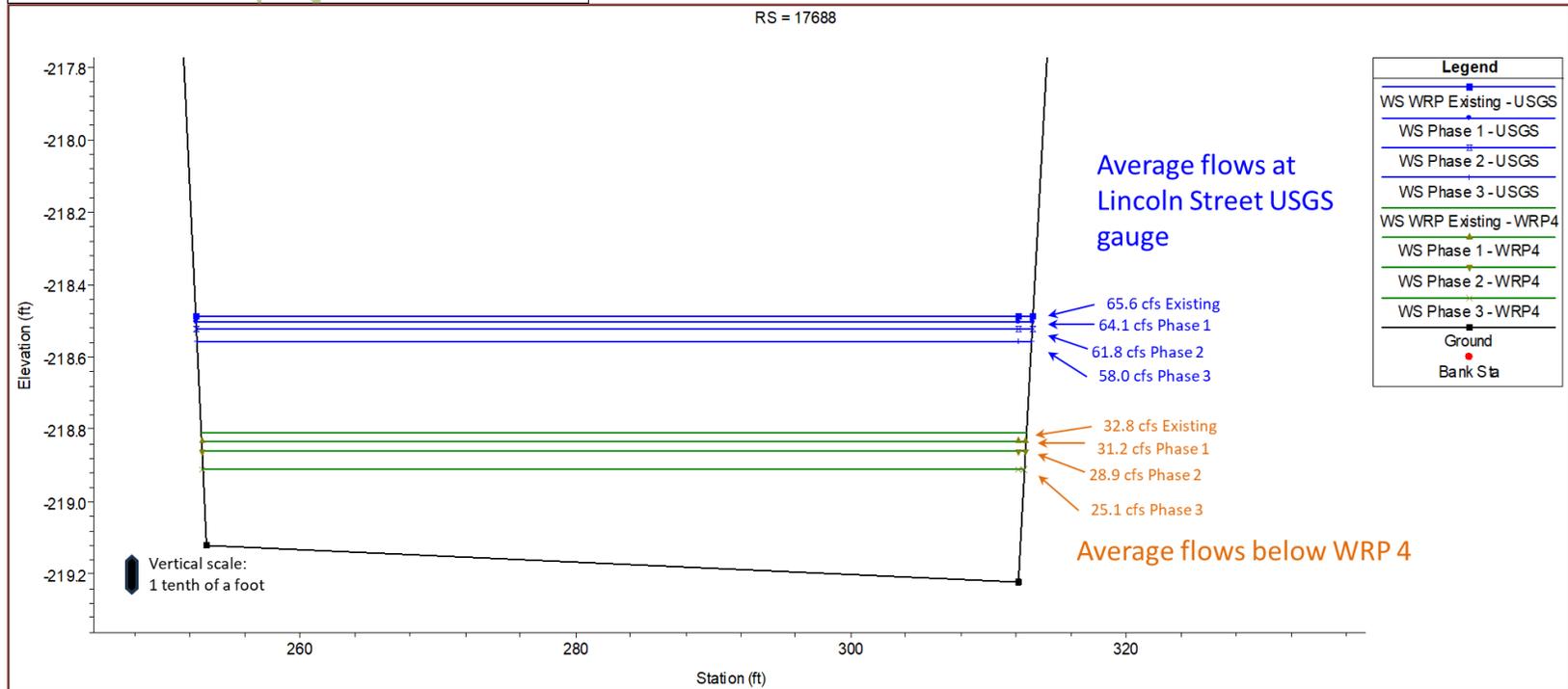
**Figure 7**  
 Estimated changes in baseflow depth and width in the Coachella Valley  
 Stormwater Channel: Cross section 2 - upstream of 66<sup>th</sup> Avenue



**Figure 8**  
 Estimated changes in baseflow depth and width in the Coachella Valley  
 Stormwater Channel: Cross section 3 - at 68<sup>th</sup> Avenue



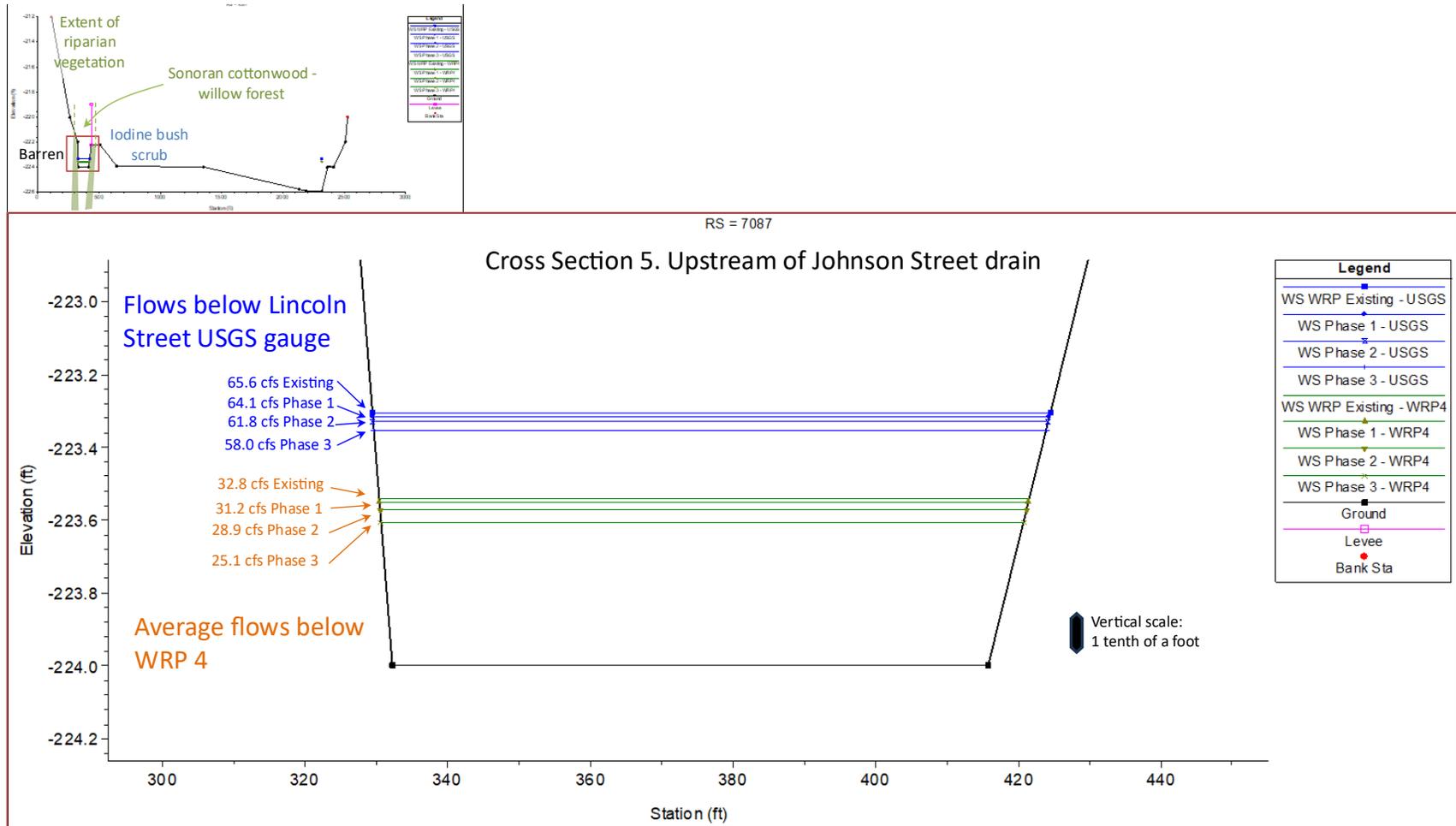
Cross Section 4. Between 70<sup>th</sup> Ave and Lincoln St USGS gauge



**Figure 9**

Estimated changes in baseflow depth and width in the Coachella Valley

Stormwater Channel: Cross section 4 - between 70<sup>th</sup> Avenue and the Lincoln Street USGS gauge



**Figure 10**  
 Estimated changes in baseflow depth and width in the Coachella Valley  
 Stormwater Channel: Cross section 5 - upstream of Johnson Street Drain

**TABLE 5**  
**ESTIMATE FLOW WIDTH IN THE COACHELLA VALLEY STORM CHANNEL UNDER EXISTING AND PROPOSED CONDITIONS**

Flow downstream of WRP 4								Flow at USGS Lincoln Street gauge							
Channel XS Station	Existing Conditions	Phase 1		Phase 2		Phase 3		Channel XS Station	Existing Conditions	Phase 1		Phase 2		Phase 3	
	Top Width (ft)	Top Width (ft)	Δ (ft)	Top Width (ft)	Δ (ft)	Top Width (ft)	Δ (ft)		Top Width (ft)	Top Width (ft)	Δ (ft)	Top Width (ft)	Δ (ft)	Top Width (ft)	Δ (ft)
(XS-1) 40769	26.86	26.79	0.07	26.68	0.18	26.49	0.37	(XS-1) 40769	28.04	28.01	0.03	27.94	0.10	27.82	0.22
39188	32.39	32.36	0.03	32.32	0.07	32.25	0.14	39188	33	32.89	0.11	32.82	0.18	32.77	0.23
38458	76.1	75.68	0.42	75.04	1.06	73.93	2.17	38458	83.56	83.27	0.29	82.81	0.75	82.04	1.52
37897	56.26	56.09	0.17	55.83	0.43	55.39	0.87	37897	59.29	59.17	0.12	58.98	0.31	58.67	0.62
36229	48.19	48	0.19	47.71	0.48	47.2	0.99	36229	51.45	51.32	0.13	51.13	0.32	50.81	0.64
(XS-2) 33976	30.73	30.57	0.16	30.32	0.41	29.88	0.85	(XS-2) 33976	34.11	33.94	0.17	33.66	0.45	33.18	0.93
33247	20.33	19.93	0.40	19.3	1.03	18.18	2.15	33247	25.98	25.87	0.11	25.72	0.26	25.5	0.48
33195	26.82	26.38	0.44	25.67	1.15	24.41	2.41	33195	31.45	31.45	0.00	31.45	0.00	31.44	0.01
32152	28.1	27.57	0.53	26.73	1.37	25.27	2.83	32152	38.31	37.78	0.53	36.92	1.39	35.24	3.07
29918	35.82	35.64	0.18	35.3	0.52	34.74	1.08	29918	39.4	39.26	0.14	39.05	0.35	38.68	0.72
(XS-3) 26769	41.61	41.54	0.07	41.42	0.19	41.2	0.41	(XS-3) 26769	43.01	42.95	0.06	42.86	0.15	42.71	0.30
26195	36.88	36.76	0.12	36.57	0.31	36.27	0.61	26195	39.16	39.07	0.09	38.93	0.23	38.68	0.48
26133	35.56	35.4	0.16	35.16	0.40	34.73	0.83	26133	38.14	38.05	0.09	37.89	0.25	37.64	0.50
26004	37.66	37.43	0.23	37.07	0.59	36.44	1.22	26004	41.47	41.33	0.14	41.11	0.36	40.73	0.74
25940	37.34	37.12	0.22	36.77	0.57	36.17	1.17	25940	41	40.86	0.14	40.65	0.35	40.29	0.71
25121	88.27	87.06	1.21	85.17	3.10	81.85	6.42	25121	109.13	108.34	0.79	107.11	2.02	105.03	4.10
22809	55.17	53.35	1.82	50.37	4.80	44.84	10.33	22809	81.94	80.96	0.98	79.47	2.47	76.82	5.12
20283	77.22	77.12	0.10	76.97	0.25	76.7	0.52	20283	79.09	79.01	0.08	78.9	0.19	78.7	0.39
(XS-4) 17688	59.95	59.9	0.05	59.83	0.12	59.69	0.26	(XS-4) 17688	60.79	60.76	0.03	60.7	0.09	60.61	0.18
14222	104.2	102.82	1.38	100.44	3.76	96.36	7.84	14222	113.02	112.97	0.05	112.92	0.10	112.81	0.21
13355	76.28	74.25	2.03	72.52	3.76	68.57	7.71	13355	95.64	95.63	0.01	95.62	0.02	95.3	0.34
10930	136.46	136.41	0.05	136.32	0.14	136.17	0.29	10930	137.39	137.35	0.04	137.3	0.09	137.2	0.19
9955	55.53	54.93	0.60	53.96	1.57	52.23	3.30	9955	65.84	65.42	0.42	64.81	1.03	63.77	2.07
9179	60.93	60.26	0.67	59.18	1.75	57.22	3.71	9179	72.49	72	0.49	71.31	1.18	70.12	2.37
(XS-5) 7087	91.23	91.02	0.21	90.69	0.54	90.12	1.11	(XS-5) 7087	95.11	94.95	0.16	94.71	0.40	94.3	0.81
<b>Average of all cross sections</b>	<b>55.04</b>	<b>54.58</b>	<b>0.46</b>	<b>53.89</b>	<b>1.14</b>	<b>52.65</b>	<b>2.38</b>	<b>Average of all cross sections</b>	<b>61.51</b>	<b>61.30</b>	<b>0.21</b>	<b>60.99</b>	<b>0.52</b>	<b>60.43</b>	<b>1.08</b>
<b>Percent Change from Existing Conditions</b>			<b>-1%</b>		<b>-2%</b>		<b>-4%</b>	<b>Percent Change from Existing Conditions</b>			<b>0%</b>		<b>-1%</b>		<b>-2%</b>

These results are discussed in the biology technical memorandum where they are compared with the depth preferences of fish with the potential to be present in the study area.

Phase 1 would reduce the wetted channel width by less than half a foot on average based on flows immediately downstream of WRP 4 (a 1% width reduction) and at Lincoln Street (less than a 0.5% reduction). Phase 2 would reduce wetted width by just over 1 foot on average for flows below WRP 4 (a 2% reduction) and just over half a foot for flows near the Lincoln Street flow gauge (a 1% reduction). Phase 3 would reduce wetted channel width by about 2.5 feet on average for flows immediately below WRP 4 (a 4% reduction) and just over a foot at Lincoln Street (a 2% reduction).

## Summary and Conclusions

Based on monthly measurements made by CVWD and the USGS between January 2018 and August 2023, discharge from WRP 4 currently makes up 23% of mean baseflow (typical flows between peak flows caused by rainfall events) in the CVSC as measured immediately below WRP 4, and 12% of mean baseflows at the Lincoln Street USGS gauge, located 2.5 miles upstream of the Salton Sea. Other flow sources in the CVSC include treated wastewater from the VSD discharge and Coachella Sanitary District (City of Coachella), stormwater runoff from the surrounding watershed, flows from a fish farm, and agricultural drainage. The proposed project would progressively reduce and then eliminate WRP 4 flows in Phases 1 through 3, as treated wastewater is reused for irrigation.

The CVSC has an area of 676 acres within the flood channel area between WRP4 and the Salton Sea, of which about 248 acres is considered to be riparian or wetland habitat that derives some or all of its water needs from the channel. Conservatively assuming that this habitat derives 100% of its water demand for evapotranspiration from baseflows in the channel (as opposed to rainfall, high flows during large runoff events, or shallow groundwater), it requires 1.9 cfs of flow on average. This compares with a mean baseflow of 32.8 cfs of flow immediately downstream of WRP 4 under existing conditions and 25.1 cfs under Phase 3 project conditions assuming zero discharge from WRP 4. Even under the lowest flow recorded upstream of WRP 4 during the six years of monitoring (18.3 cfs), the evapotranspiration demand would represent about 10% of the lowest baseflow in the CVSC. The proposed WRP 4 flow reductions are therefore unlikely to impact existing riparian or wetland habitat within the CVSC, as sufficient CVSC flow will continue to be available to meet vegetation evapotranspiration demand.

Hydraulic modeling was performed to determine how much the proposed flow reductions will reduce flow depths and wetted areas downstream of WRP 4 under baseflow conditions. Flow depth reductions are estimated to be minimal in Phases 1 and 2 (a few hundredths of a foot on average, representing 1-2% of existing depth for Phase 1 and 3-5% for Phase 2). For Phase 3, average depth reductions are about a tenth of a foot, representing 10% of the existing depth for flows near WRP 4 and 5% for flows near the USGS gauge at Lincoln Street. The biology technical memorandum compares these flow depths with the habitat preferences of fish with the potential to be present in the study reach.

Flow widths are estimated to be reduced by less than half a foot (Phase 1) to around 1 foot (Phase 2) and 2.4 feet (Phase 3) for flows at WRP 4, representing width reductions of 1, 2 and 4% respectively. For flows at the Lincoln Street USGS gauge the estimated reductions are less than a quarter of a foot for Phase 1, around half a foot for Phase 2 and 1.1 feet for Phase 3, representing 0, 1 and 2% reductions in

flow width compared to existing conditions. These changes are much smaller than the changes in width that occur on a regular basis due to changes in stormwater and variability in other flow sources, and are not likely to impact the adjacent vegetation. The proposed project is unlikely to change the pattern of soil moisture in the root zones adjacent to the pilot channel.

The changes in flow depth and width, combined with the evapotranspiration analysis, indicate that there will still be sufficient flow in the channel following Phase 3 of the proposed project to support the existing riparian and aquatic habitat with no loss of habitat, due to the small volume of flow reduction proportional to the volumes of baseflow in the channel from other sources.

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Attachment A  
**Monthly Evapotranspiration and  
Crop Adjustment Values**

Ground Cover	Monthly Mean Evapotranspiration (inches)												Total Annual ET <sub>v</sub> (inches)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Reference cover (irrigated grass) (ET <sub>o</sub> ) inches	2.7	3.9	6.3	8.0	9.1	9.7	9.6	9.0	7.1	5.3	3.3	2.4	76.4
Small stand permanent wetland crop adjustment factor (K <sub>v</sub> )	1.0	1.1	1.5	1.5	1.6	1.7	1.9	1.6	1.5	1.2	1.2	1.0	
Small stand permanent wetland (ET <sub>v</sub> ) inches	2.7	4.3	9.5	12.0	14.6	16.4	18.3	14.5	10.6	6.3	3.7	2.4	115.3
Cottonwood riparian woodland crop adjustment factor (K <sub>v</sub> )	0.8	0.7	0.6	0.7	0.8	0.9	1.0	1.0	1.1	1.1	0.9	0.9	
Cottonwood riparian woodland (ET <sub>v</sub> ) inches	2.2	2.8	3.9	5.3	7.5	9.1	9.8	9.2	7.6	5.7	2.9	2.1	68.0
Willow riparian woodland crop adjustment factor (K <sub>v</sub> )	0.8	0.7	0.6	0.6	0.7	0.9	0.9	1.0	1.1	1.1	0.9	0.9	
Willow riparian woodland (ET <sub>v</sub> ) inches	2.2	2.6	3.5	4.7	6.7	8.3	9.0	8.6	7.6	5.5	2.8	2.1	63.6